Central Board of Secondary Education

Question Paper Name :	B Tech 10 Apr 2015 Single slot
Subject Name :	B. Tech
Duration :	180
Total Marks :	360
Display Marks:	Yes

B. Tech

Group Number :	1
Group Maximum Duration :	0
Group Minimum Duration :	180
Show Attended Group? :	No
Edit Attended Group? :	No
Break time :	0
Group Marks :	360

Mathematics Section A

Section Number :	1
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 1 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The largest value of r, for which the region represented by the set $\{\omega \in C||\omega - 4 - i| \leq r\}$ is contained in the region represented by the set $\{z \in C||z - 1| \leq |z + i|\}$, is equal to :

(1) $2\sqrt{2}$ (2) $\frac{3}{2}\sqrt{2}$

(3) $\sqrt{17}$ (4) $\frac{5}{2}\sqrt{2}$

Question Number : 2 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $2 + 3i$ is one of the roots of the equation $2x^3 - 9x^2 + kx - 13 = 0,\ k \in R$, then the real root of this equation (where $i^2 = -1$) :

(1) Exists and is equal to $\frac{1}{2}$ (2) Does not exist

(3) Exists and is equal to 1 (4) Exists and is equal to $-\frac{1}{2}$

Question Number : 3 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The number of ways of selecting 15 teams from 15 men and 15 women, such that each team consists of a man and a woman is

(1) 1960 (2) 15!

(3) $(15!)^2$ (4) 14!

Question Number : 4 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The value of $\sum_{r=16}^{30}(r+2)(r-3)$ is equal to:

(1) 7775 (2) 7785

(3) 7780 (4) 7770

Question Number : 5 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let the sum of the first three terms of an A.P. be 39 and the sum of its last four terms be 178. If the first term of this A.P. is 10, then the median of the A.P. is :

(1) 26.5 (2) 29.5

(3) 28 (4) 31

Question Number : 6 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the coefficient of the three successive terms in the binomial expansion of $(1+x)^n$ are in the ratio $1:7:42$, then the first of these terms in the expansion is

(1) 9^{th} (2) 6^{th}

(3) 8^{th} (4) 7^{th}

Question Number : 7 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In a ΔABC, $\frac{a}{b}=2+\sqrt{3}$, and $\angle C=60^\circ$. Then the ordered pair $(\angle A, \angle B)$ is equal to:

(1) $(105^\circ,\ 15^\circ)$ (2) $(15^\circ,\ 105^\circ)$

(3) $(45^\circ,\ 75^\circ)$ (4) $(75^\circ,\ 45^\circ)$

Question Number : 8 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let L be the line passing through the point $P(1,2)$ such that its intercepted segment between the co-ordinate axes is bisected at P. If L_1 is the line perpendicular to L and passing through the point $(-2,\ 1)$, then the point of intersection of L and L_1 is

(1) $\left(\frac{3}{5}, \frac{23}{10}\right)$ (2) $\left(\frac{4}{5}, \frac{12}{5}\right)$

(3) $\left(\frac{11}{20}, \frac{29}{10}\right)$ (4) $\left(\frac{3}{10}, \frac{17}{5}\right)$

Question Number : 9 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The points $\left(0, \frac{8}{3}\right), (1,3)$ and $(82,30)$

(1) form an obtuse angled triangle (2) form an acute angled triangle

(3) lie on a straight line (4) form a right angled triangle

Question Number : 10 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $y+3x=0$ is the equation of a chord of the circle $x^2+y^2-30x=0$, then the equation of the circle with this chord as diameter is :

(1) $x^2+y^2+3x-9y=0$ (2) $x^2+y^2-3x+9y=0$

(3) $x^2+y^2+3x+9y=0$ (4) $x^2+y^2-3x-9y=0$

Question Number : 11 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let the tangents drawn to the circle, $x^2+y^2=16$ from the point $P(0,h)$ meet the x-axis at points A and B. If the area of ΔAPB is minimum, then positive value of h is:

(1) $4\sqrt{2}$ (2) $3\sqrt{2}$

(3) $4\sqrt{3}$ (4) $3\sqrt{3}$

Question Number : 12 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the tangent to the conic, $y-6=x^2$ at $(2,10)$ touches the circle, $x^2+y^2+8x-2y=k$ (for some fixed k) at a point $(\alpha,\ \beta)$; then $(\alpha,\ \beta)$ is

(1) $\left(-\frac{7}{17},\ \frac{6}{17}\right)$ (2) $\left(-\frac{8}{17},\ \frac{2}{17}\right)$

(3) $\left(-\frac{6}{17},\ \frac{10}{17}\right)$ (4) $\left(-\frac{4}{17},\ \frac{1}{17}\right)$

Question Number : 13 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

An ellipse passes through the foci of the hyperbola, $9x^2-4y^2=36$ and its major and minor axes lie along the transverse and conjugate axes of the hyperbola respectively. If the product of eccentricities of the two conics is $\frac{1}{2}$, then which of the following points does not lie on the ellipse?

(1) $\left(\frac{\sqrt{39}}{2},\ \sqrt{3}\right)$ (2) $\left(\frac{\sqrt{13}}{2},\ \frac{\sqrt{3}}{2}\right)$

(3) $\left(\sqrt{\frac{13}{2}},\ \sqrt{6}\right)$ (4) $\left(\sqrt{13},\ 0\right)$

Question Number : 14 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

$\lim\limits_{x\to 0}\frac{e^{x^2}-\cos x}{\sin^2 x}$ is equal to

(1) 2 (2) $\frac{3}{2}$

(3) $\frac{5}{4}$ (4) 3

Question Number : 15 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The contrapositive of the statement "If it is raining, then I will not come", is

(1) if I will come, then it is not raining. (2) if I will come, then it is raining.

(3) if I will not come, then it is raining. (4) if I will not come, then it is not raining.

Question Number : 16 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A factory is operating in two shifts, day and night, with 70 and 30 workers, respectively.If per day mean wage of the day shift workers is, ₹ 54 and per day mean wage of all the workers is ₹ 60, then per day mean wage of the night shift workers (in ₹) is :

(1) 75 (2) 74

(3) 69 (4) 66

Question Number : 17 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In a certain town, 25% of the families own a phone and 15% own a car; 65% families own neither a phone nor a car and 2000 families own both a car and a phone. Consider the following three statements:

(i) 5% families own both a car and a phone.

(ii) 35% families own either a car or a phone.

(iii) 40000 families live in the town.

Then,

(1) Only (ii) and (iii) are correct (2) Only (i) and (ii) are correct

(3) All (i), (ii) and (iii) are correct (4) Only (i) and (iii) are correct

Question Number : 18 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $A=\begin{bmatrix}0 & -1\\ 1 & 0\end{bmatrix}$, then which one of the following statements is not correct?

(1) $A^3+I=A\left(A^3-\ I\right)$ (2) $A^4-I=A^2+I$

(3) $A^2+I=A\left(A^2-I\right)$ (4) $A^3-I=A\left(A-I\right)$

Question Number : 19 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The least value of the product xyz (such that x, y and z are positive real numbers) for which the determinant $\begin{vmatrix} x & 1 & 1 \\ 1 & y & 1 \\ 1 & 1 & z \end{vmatrix}$ is non-negative is

(1) -1 (2) $-16\sqrt{2}$

(3) -8 (4) $-2\sqrt{2}$

Question Number : 20 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $f(x) = 2\tan^{-1} x + \sin^{-1}\left(\frac{2x}{1+x^2}\right),\ x > 1$, then $f(5)$ is equal to

(1) $\frac{\pi}{2}$ (2) $\tan^{-1}\left(\frac{65}{156}\right)$

(3) π (4) $4\tan^{-1}(5)$

Question Number : 21 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If Rolle's theorem holds for the function $f(x) = 2x^3 + bx^2 + cx,\ x \in [-1, 1]$ at the point $x = \frac{1}{2}$, then $2b + c$ is equal to

(1) 2 (2) 1

(3) -1 (4) -3

Question Number : 22 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The distance from the origin, of the normal to the curve, $x = 2\cos t + 2t\sin t,\ y = 2\sin t - 2t\cos t$ *at* $t = \frac{\pi}{4}$, is :

(1) $\sqrt{2}$ (2) $2\sqrt{2}$

(3) 4 (4) 2

Question Number : 23 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The integral $\int \frac{dx}{(x+1)^{\frac{3}{4}}(x-2)^{\frac{5}{4}}}$, is equal to

(1) $4\left(\frac{x-2}{x+1}\right)^{\frac{1}{4}} + c$ (2) $-\frac{4}{3}\left(\frac{x+1}{x-2}\right)^{\frac{1}{4}} + c$

(3) $4\left(\frac{x+1}{x-2}\right)^{\frac{1}{4}} + c$ (4) $-\frac{4}{3}\left(\frac{x-2}{x+1}\right)^{\frac{1}{4}} + c$

Question Number : 24 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

For $x > 0$, let $f(x) = \int_1^x \frac{\log t}{1+t}\, dt$. Then $f(x) + f\left(\frac{1}{x}\right)$ is equal to

(1) $\frac{1}{2}(\log x)^2$ (2) $\log x$

(3) $\frac{1}{4}\log x^2$ (4) $\frac{1}{4}(\log x)^2$

Question Number : 25 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The area (in square units) of the region bounded by the curves $y + 2x^2 = 0$ and $y + 3x^2 = 1$, is equal to

(1) $\frac{3}{4}$ sq. units (2) $\frac{1}{3}$ sq. units

(3) $\frac{3}{5}$ sq. units (4) $\frac{4}{3}$ sq. units

Question Number : 26 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $y(x)$ is the solution of the differential equation $(x+2)\frac{dy}{dx} = x^2 + 4x - 9,\ x \neq -2$ and $y(0) = 0$, then $y(-4)$ is equal to

(1) -1 (2) 1

(3) 0 (4) 2

Question Number : 27 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let $\vec{a}$and $\vec{b}$ be two unit vectors such that $\left|\vec{a}+\vec{b}\right| = \sqrt{3}$. If $\vec{c}=\vec{a}+2\vec{b}+\left(\vec{a}\times\vec{b}\right)$, then $2\left|\vec{c}\right|$ is equal to:

(1) $\sqrt{51}$ (2) $\sqrt{37}$

(3) $\sqrt{43}$ (4) $\sqrt{55}$

Question Number : 28 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the points $(1,\ 1,\ \lambda)$ & $(-3,\ 0,\ 1)$, are equidistant from the plane, $3x+4y-12z+13=0$, then λ satisfies the equation:

(1) $3x^2+10x+7=0$ (2) $3x^2+10x-13=0$

(3) $3x^2-10x+7=0$ (4) $3x^2-10x+21=0$

Question Number : 29 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the shortest distance between the line $\frac{x-1}{\alpha}=\frac{y+1}{-1}=\frac{z}{1}, (\alpha\neq -1)$, and $x+y+z+1=0=2x-y+z+3$ is $\frac{1}{\sqrt{3}}$,then value of α is :

(1) $-\frac{19}{16}$ (2) $\frac{32}{19}$

(3) $-\frac{16}{19}$ (4) $\frac{19}{32}$

Question Number : 30 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let X be a set containing 10 elements and $\mathrm{P(X)}$ be its power set. If A and B are picked up at random from $\mathrm{P(X)}$, with replacement, then the probability that A and B have equal number of elements is:

(1) $\frac{\left(2^{10}-1\right)}{2^{20}}$ (2) $\frac{{}^{20}C_{10}}{2^{20}}$

(3) $\frac{{}^{20}C_{10}}{2^{10}}$ (4) $\frac{\left(2^{10}-1\right)}{2^{10}}$

Physics Section A

Section Number :	2
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 31 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the capacitance of a nanocapacitor is measured in terms of a unit u, made by combining the electronic charge e, Bohr radius a_0, Planck's constant h and speed of light c then

(1) $u=\frac{e^2a_0}{hc}$ (2) $u=\frac{hc}{e^2a_0}$

(3) $u=\frac{e^2c}{ha_0}$ (4) $u=\frac{e^2h}{ca_0}$

Question Number : 32 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A block of mass $m = 10$ kg rests on a horizontal table. The coefficient of friction between the block and the table is 0.05. When hit by a bullet of mass 50 g moving with speed v, that gets embedded in it, the block moves and comes to stop after moving a distance of 2 m on the table. If a freely falling object were to acquire speed $\frac{v}{10}$ after being dropped from height H, then neglecting energy losses and taking $g = 10\ \text{m s}^{-2}$, the value of H is close to

(1) 0.2 km.
(2) 0.5 km.
(3) 0.4 km.
(4) None of these.

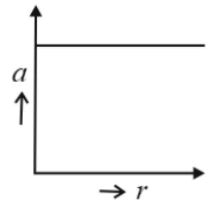
Question Number : 33 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

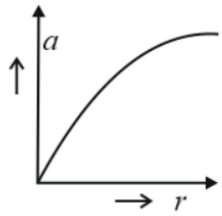
A block of mass $m = 0.1$ kg is connected to a spring of unknown spring constant k. It is compressed to a distance x from its equilibrium position and released from rest. After approaching half the distance $\left(\frac{x}{2}\right)$ from the equilibrium position, it hits another block and comes to rest momentarily, while the other block moves with velocity $3\ \text{m s}^{-1}$. The total initial energy of the spring is:

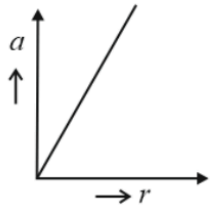
(1) 0 .6 J
(2) 0 .8 J
(3) 1 .5 J
(4) 0 .3 J

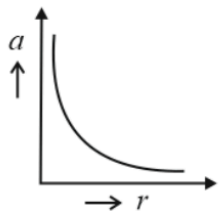
Question Number : 34 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If a body moving in a circular path maintains constant speed of $10\ \text{m s}^{-1}$, then which of the following correctly describes the relation between acceleration and radius?

(1)


(2)


(3)


(4)


Question Number : 35 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Consider a thin uniform square sheet made of a rigid material. If its side is a, mass m and moment of inertia I about one of its diagonals, then:

(1) $I = \frac{ma^2}{24}$
(2) $\frac{ma^2}{24} < I < \frac{ma^2}{12}$
(3) $I > \frac{ma^2}{12}$
(4) $I = \frac{ma^2}{12}$

Question Number : 36 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A uniform solid cylindrical roller of mass m is being pulled on a horizontal surface with force F parallel to the surface and applied at its centre. If the acceleration of the cylinder is a and it is rolling without slipping then the value of F is:

(1) $\frac{3}{2}\ ma$
(2) $2\ ma$
(3) $\frac{5}{3}\ ma$
(4) ma

Question Number : 37 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A very long (length L) cylindrical galaxy is made of uniformly distributed mass and has radius R ($R << L$). A star outside the galaxy is orbiting the galaxy in a plane perpendicular to the galaxy and passing through its centre. If the time period of the star is T and its distance from the galaxy's axis is r, then

(1) $T \propto \sqrt{r}$

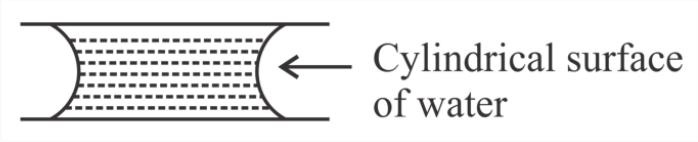
(2) $T \propto r$

(3) $T \propto r^2$

(4) $T^2 \propto r^3$

Question Number : 38 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If two glass plates have water between them and are separated by very small distance (see figure), it is very difficult to pull them apart. It is because the water in between forms cylindrical surface on the side that gives rise to lower pressure in the water in comparison to atmosphere. If the radius of the cylindrical surface is R and surface tension of water is T then the pressure in water between the plates is lower by:



(1) $\frac{T}{R}$

(2) $\frac{T}{4R}$

(3) $\frac{4T}{R}$

(4) $\frac{2T}{R}$

Question Number : 39 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If it takes 5 minutes to fill a 15 litre bucket from a water tap of diameter $\frac{2}{\sqrt{\pi}}\ cm$ then the Reynolds number for the flow is (density of water = $10^3\ kg/m^3$ *and viscosity of water* $= 10^{-3}\ Pa.\ s$) close to:

(1) 5500

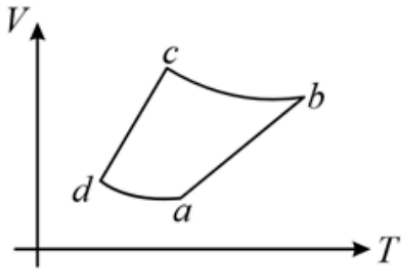
(2) 550

(3) 1100

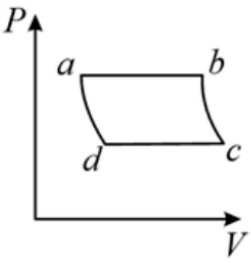
(4) 11,000

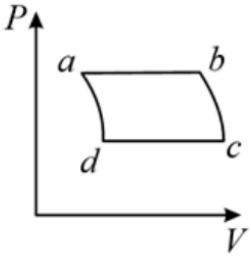
Question Number : 40 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

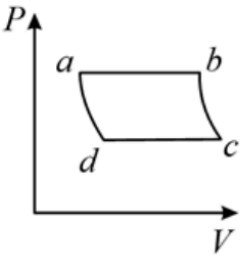
An ideal gas goes through a reversible cycle $a \to b \to c \to d$ has the V - T diagram shown below. Process $d \to a \; and \; b \to c$ are adiabatic.

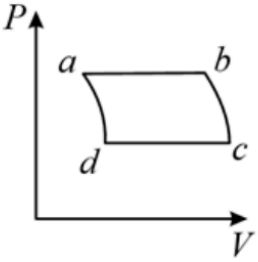


The corresponding P - V diagram for the process is (all figures are schematic and not drawn to scale) :

(1)


(2)


(3)


(4)


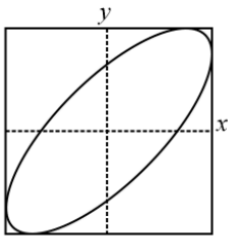
Question Number : 41 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

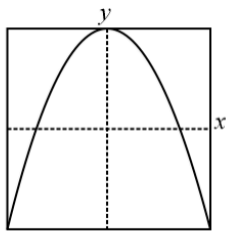
In an ideal gas at temperature T, the average force that a molecule applies on the walls of a closed container depends on $T \; as \; T^q$. A good estimate for q is:

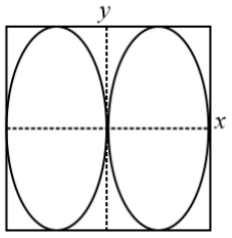
(1) 2
(2) $\frac{1}{2}$
(3) 1
(4) $\frac{1}{4}$

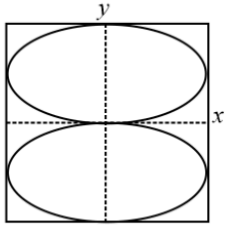
Question Number : 42 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

$x \; and \; y$ displacements of a particle are given as $x(t) = a \sin \omega t \; and \; y(t) = a \sin 2\omega t$. Its trajectory will look like:

(1)


(2)


(3)


(4)


Question Number : 43 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A simple harmonic oscillator of angular frequency 2 rad s^{-1} is acted upon by an external force $F = \sin t\ N$. If the oscillator is at rest in its equilibrium position at $t = 0$, its position at later times is proportional to:

(1) $\sin t + \frac{1}{2}\cos 2t$

(2) $cost - \frac{1}{2}\sin 2t$

(3) $\sin t - \frac{1}{2}\sin 2t$

(4) $\sin t + \frac{1}{2}\sin 2t$

Question Number : 44 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A bat moving at 10 m s^{-1} towards a wall sends a sound signal of 8000 Hz towards it. On reflection, it hears a sound of frequency f. The value of f in Hz is close to

$\left(\text{speed of sound} = 320\,\text{m s}^{-1}\right)$

(1) 8258

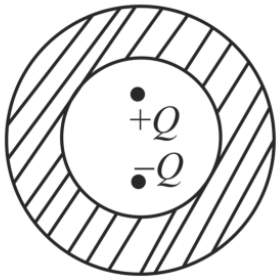
(2) 8424

(3) 8000

(4) 8516

Question Number : 45 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Shown in the figure are two point charges $+Q$ and $-Q$ inside the cavity of a spherical shell. The charges are kept near the surface of the cavity on opposite sides of the centre of the shell. If σ_1 is the surface charge on the inner surface and Q_1 net charge on it and σ_2 the surface charge on the outer surface and Q_2 net charge on it then:



(1) $\sigma_1 = 0,\ Q_1 = 0\ , \sigma_2 = 0,\ Q_2 = 0$

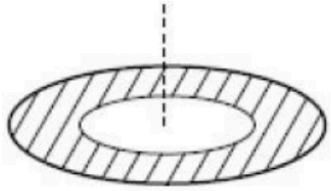
(2) $\sigma_1 \neq 0,\ Q_1 = 0\ , \sigma_2 \neq 0,\ Q_2 = 0$

(3) $\sigma_1 \neq 0, Q_1 \neq 0\ , \sigma_2 \neq 0,\ Q_2 \neq 0$

(4) $\sigma_1 \neq 0,\ Q_1 = 0\ , \sigma_2 = 0,\ Q_2 = 0$

Question Number : 46 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A thin disc of radius $b = 2a$ has a concentric hole of radius a in it (see figure). It carries uniform surface charge σ on it. If the electric field on its axis at a height h(h << a) from its centre is given as Ch then the value of C is



(1) $\frac{\sigma}{4\,a\epsilon_0}$

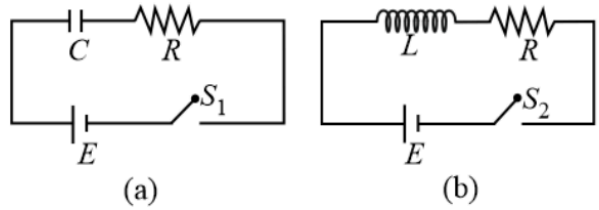
(2) $\frac{\sigma}{a\epsilon_0}$

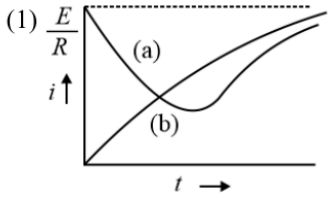
(3) $\frac{\sigma}{5a\epsilon_0}$

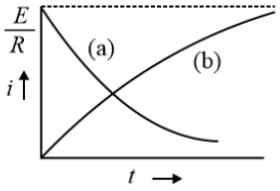
(4) $\frac{\sigma}{2a\epsilon_0}$

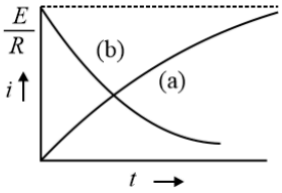
Question Number : 47 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

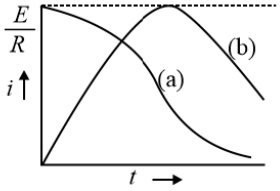
In the given circuits (a) and (b), switches S_1 and S_2 are closed at $t = 0$ and kept close for a long time. The variation of currents in the two circuits for $t \geq 0$ are shown in the options. (Figures are schematic and not drawn to scale.)



(1) 

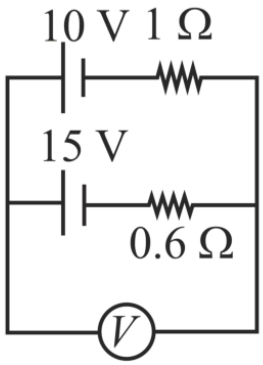
(2) 

(3) 

(4) 

Question Number : 48 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A 10 V battery with internal resistance 1 Ω and a 15 V battery with internal resistance 0.6 Ω are connected in parallel to a voltmeter (see figure). The reading in the voltmeter will be close to:



(1) 11.9 V

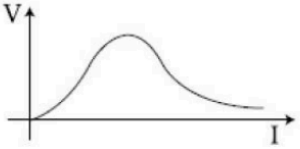
(2) 13.1 V

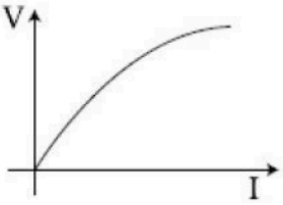
(3) 12.5 V

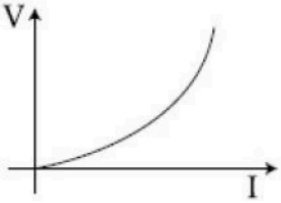
(4) 24.5 V

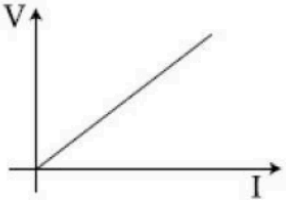
Question Number : 49 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Suppose the drift velocity v_d in a material varied with the applied electric field E as $v_d \propto \sqrt{E}$. Then $V - I$ graph for a wire made of such a material is best given by:

(1) 

(2) 

(3) 

(4) 

Question Number : 50 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

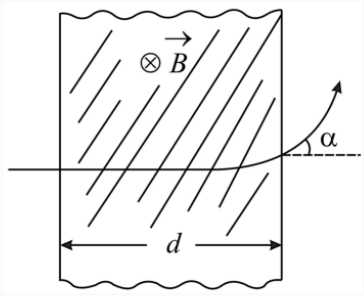
A 25 cm long solenoid has the radius 2 cm and 500 turns. It carries a current of 15 A. If it is equivalent to a magnet of the same size and magnetization $\vec{M}$ $\left(\frac{Magnetic\ moment}{volume}\right)$,then $\left|\vec{M}\right|$ is:

(1) 3π A m^{-1} (2) 30000 A m^{-1}

(3) 30000π A m^{-1} (4) 300 A m^{-1}

Question Number : 51 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A proton (mass m) accelerated by a potential difference V flies through a uniform transverse magnetic field B. The field occupies a region of space by width d. If α be the angle of deviation of proton from the initial direction of motion (see figure), the value of $\sin\alpha$ will be:



(1) $\frac{B}{2}\sqrt{\frac{qd}{mV}}$ (2) $Bd\sqrt{\frac{q}{2mV}}$

(3) $\frac{B}{d}\sqrt{\frac{q}{2mV}}$ (4) $qV\sqrt{\frac{Bd}{2m}}$

Question Number : 52 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

When the current in a coil changes from 5 A to 2 A in 0.1 s, an average voltage of 50 V is produced. The self-inductance of the coil is

(1) 1.67 H (2) 6 H

(3) 3 H (4) 0.67 H

Question Number : 53 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

An electromagnetic wave travelling in the $x-$ direction has frequency of 2×10^{14} Hz and electric field amplitude of $27\ \mathrm{V\ m^{-1}}$ oscillates in $Y-$direction. From the options given below, which one describes the magnetic field for this wave?

(1) $\vec{B}(x,\ t)=\left(9\times10^{-8}\ \mathrm{T}\right)\hat{\mathrm{j}}$ $\sin\left[1.5\times10^{-6}\ x-2\times10^{14}t\right]$ (2) $\vec{B}(x,\ t)=\left(9\times10^{-8}T\right)\hat{\mathrm{i}}\sin\left[2\pi\left(1.5\times10^{-8}\ x-2\times10^{14}\right.\right.$

(3) $\vec{B}$ $(x,t)=\left(3\times10^{-8}\mathrm{T}\right)\hat{\mathrm{j}}\sin2\pi\left[\left(\frac{\mathrm{x}}{1.5\times10^{-8}}\right)-2\times10^{14}t\right]$ (4) $\vec{B}$ $(x,t)=\left(9\times10^{-8}\mathrm{T}\right)\hat{\mathrm{k}}\sin2\pi\left[\left(\frac{x}{1.5\times10^{-6}}\right)-2\times10^{14}t\right]$

Question Number : 54 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A telescope has an objective lens of focal length 150 cm and an eyepiece of focal length 5 cm. If a 50 m tall tower at a distance of 1 km is observed through this telescope in a normal setting, the angle formed by the image of the tower is θ, then θ is close to

(1) 30° (2) 15°

(3) 1° (4) 86°

Question Number : 55 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

You are asked to design a shaving mirror assuming that a person keeps it at 10 cm from his face and views the magnified image of the face at the closest comfortable distance of 25 cm. The radius of curvature of the mirror would then be:

(1) 24 cm

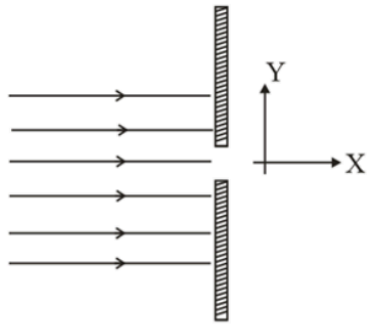
(2) 30 cm

(3) 60 cm

(4) -24 cm

Question Number : 56 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A parallel beam of electrons travelling in x - direction falls on a slit of width d (see figure). If after passing the slit, an electron acquires momentum p_y in the y - direction then for a majority of electrons passing through the slit (h is Planck's constant):



(1) $|p_y|d < h$

(2) $|p_y|d > h$

(3) $|p_y|d \simeq h$

(4) $|p_y|d >> h$

Question Number : 57 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

De-Broglie wavelength of an electron accelerated by a voltage of 50 V is close to

$\left(|e| = 1.6 \times 10^{-19}\text{ C},\ m_e = 9.1 \times 10^{-31}\text{ kg},\ \ h = 6.6 \times 10^{-34}\text{ J s}\right)$

(1) 0.5 Å

(2) 1.2 Å

(3) 1.7 Å

(4) 2.4 Å

Question Number : 58 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If one were to apply the Bohr model to a particle of mass 'm' and charge 'q' moving in a plane under the influence of a magnetic field 'B', the energy of the charged particle in the n^{th} level will be:

(1) $n\left(\frac{hqB}{\pi m}\right)$

(2) $n\left(\frac{hqB}{4\pi m}\right)$

(3) $n\left(\frac{hqB}{2\pi m}\right)$

(4) $n\left(\frac{hqB}{8\pi m}\right)$

Question Number : 59 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In an unbiased p - n junction electrons diffuse from n-region to p-region because:

(1) electrons travel across the junction due to potential difference

(2) only electrons move from n to p region and not the vice - versa

(3) electron concentration in n - region is more as compared to that in p - region

(4) holes in p - region attract them

Question Number : 60 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Diameter of a steel ball is measured using a Vernier calipers which has divisions of 0.1 cm on its main scale (MS) and 10 divisions of its Vernier scale (VS) match 9 divisions on the main scale. Three such measurements for a ball are given as:

S.No.	MS (cm)	VS divisions
1.	0.5	8
2.	0.5	4
3.	0.5	6

If the zero error is - 0.03 cm, then mean corrected diameter is:

(1) $0.53\ \text{cm}$ (2) $0.56\ \text{cm}$

(3) $0.59\ \text{cm}$ (4) $0.52\ \text{cm}$

Chemistry Section A

Section Number :	3
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 61 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A sample of a hydrate of barium chloride weighing 61 g was heated until all the water of hydration is removed. The dried sample weighed 52 g. The formula of the hydrated salt is: (atomic mass, Ba = 137 amu, Cl = 35.5 amu)

(1) $BaCl_2 \cdot H_2O$ (2) $BaCl_2 \cdot 3H_2O$

(3) $BaCl_2 \cdot 4H_2O$ (4) $BaCl_2 \cdot 2H_2O$

Question Number : 62 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the principal quantum number $n = 6$, the correct sequence of filling of electrons will be:

(1) $ns \rightarrow (n-1)\,d \rightarrow (n-2)\,f \rightarrow np$ (2) $ns \rightarrow np \rightarrow (n-1)d \rightarrow (n-2)f$

(3) $ns \rightarrow (n-2)f \rightarrow np \rightarrow (n-1)d$ (4) $ns \rightarrow (n-2)f \rightarrow (n-1)d \rightarrow np$

Question Number : 63 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In the long form of the periodic table, the valence shell electronic configuration of $5s^2 5p^4$ corresponds to the element present in:

(1) Group 16 and period 5 (2) Group 17 and period 5

(3) Group 16 and period 6 (4) Group 17 and period 6

Question Number : 64 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The shape of $XeOF_4$ by VSEPR theory is:

(1) Trigonal bipyramidal (2) Square pyramidal

(3) Pentagonal planar (4) Octahedral

Question Number : 65 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

After understanding the assertion and reason, choose the correct option.

Assertion: In the bonding molecular orbital (MO) of H_2, electron density is increased between the nuclei.

Reason: The bonding MO is $\psi_A + \psi_B$, which shows destructive interference of the combining electron waves.

(1) Assertion and Reason are correct, but Reason is not the correct explanation for the Assertion.

(2) Assertion and Reason are correct and Reason is the correct explanation for the Assertion.

(3) Assertion is incorrect, Reason is correct.

(4) Assertion is correct, Reason is incorrect.

Question Number : 66 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which of the following is **not** an assumption of the kinetic theory of gases?

(1) Collisions of gas particles are perfectly elastic.

(2) A gas consists of many identical particles which are in continual motion.

(3) At high pressure, gas particles are difficult to compress.

(4) Gas particles have negligible volume.

Question Number : 67 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The heat of atomization of methane and ethane are $360\ \text{kJ}\ \text{mol}^{-1}$ and $620\ \text{kJ}\ \text{mol}^{-1}$, respectively. The longest wavelength of light capable of breaking the C − C bond is (Avogadro's number $= 6.023 \times 10^{23}$, $\text{h} = 6.62 \times 10^{-34}$ J s)

(1) $2.48 \times 10^4\ \text{nm}$

(2) $1.49 \times 10^4\ \text{nm}$

(3) $2.48 \times 10^3\ \text{nm}$

(4) $1.49 \times 10^3\ \text{nm}$

Question Number : 68 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Gaseous N_2O_4 dissociates into gaseous NO_2 according to the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

At 300 K and 1 atm pressure, the degree of dissociation of N_2O_4 is 0.2. If one mole of N_2O_4 gas is contained in a vessel, then the density of the equilibrium mixture is:

(1) $3.11\ \text{g/L}$

(2) $1.56\ \text{g/L}$

(3) $4.56\ \text{g/L}$

(4) $6.22\ \text{g/L}$

Question Number : 69 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Permanent hardness in water cannot be cured by:

(1) Treatment with washing soda

(2) Ion exchange method

(3) Calgon's method

(4) Boiling

Question Number : 70 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The correct order of thermal stability of hydroxides is

(1) $Mg(OH)_2 < Sr(OH)_2 < Ca(OH)_2 < Ba(OH)_2$

(2) $Mg(OH)_2 < Ca(OH)_2 < Sr(OH)_2 < Ba(OH)_2$

(3) $Ba(OH)_2 < Sr(OH)_2 < Ca(OH)_2 < Mg(OH)_2$

(4) $Ba(OH)_2 < Ca(OH)_2 < Sr(OH)_2 < Mg(OH)_2$

Question Number : 71 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

1.4 g of an organic compound was digested according to Kjeldahl's method and the ammonia evolved was absorbed in 60 mL of M/10 H_2SO_4 solution. The excess sulphuric acid required 20 mL of M/10 NaOH solution for neutralization. The percentage of nitrogen in the compound is:

(1) 24

(2) 3

(3) 5

(4) 10

Question Number : 72 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The optically inactive compound from the following is:

(1) 2-chloropropanal

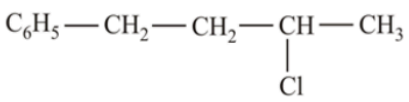
(2) 2-chloro-2-methylbutane

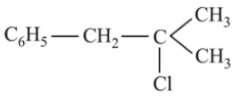
(3) 2-chlorobutane

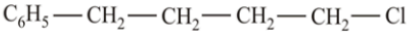
(4) 2-chloropentane

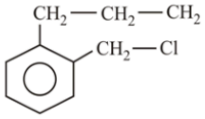
Question Number : 73 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A compound A with molecular formula $C_{10}H_{13}Cl$, gives a white precipitate on adding silver nitrate solution. A on reacting with alcoholic KOH gives compound B as the main product. B on ozonolysis, gives C and D. C gives Cannizaro reaction, but not aldol condensation. D gives aldol condensation, but not Cannizaro reaction. A is

(1) 

(2) 

(3) 

(4) 

Question Number : 74 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Photochemical smog consists of excessive amount of X, in addition to aldehydes, ketones, peroxy acetyl nitrile (PAN). X is:

(1) CH_4

(2) CO_2

(3) O_3

(4) CO

Question Number : 75 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A solution at $20^{\circ}C$ is composed of 1.5 mol of benzene and 3.5 mol of toluene. If the vapour pressure of pure benzene and pure toluene at this temperature are 74.7 torr and 22.3 torr respectively, then the total vapour pressure of the solution and the benzene mole fraction in equilibrium with it will be, respectively:

(1) 30.5 torr and 0.389

(2) 35.0 torr and 0.480

(3) 38.0 torr and 0.589

(4) 35.8 torr and 0.280

Question Number : 76 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A variable, the opposite external potential (E_{ext}) is applied to the cell $Zn \mid Zn^{2+}\ (1M) \parallel Cu^{2+}\ (1\ M) \mid Cu$, of potential 1.1 V. When $E_{ext} < 1.1$ V and $E_{ext} > 1.1$ V, respectively electrons flow from

(1) anode to cathode in both the cases.

(2) anode to cathode and cathode to anode.

(3) cathode to anode and anode to cathode.

(4) cathode to anode in both cases.

Question Number : 77 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The reaction $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ follows first order kinetics. The pressure of a vessel containing only N_2O_5 was found to increase from 50 mm Hg to 87.5 mm Hg in 30 min. The pressure exerted by the gases after 60 min. Will be (Assume temperature remains constant) :

(1) 106.25 mm Hg

(2) 125 mm Hg

(3) 116.25 mm Hg

(4) 150 mm Hg

Question Number : 78 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The following statements relate to the adsorption of gases on a solid surface. Identify the **incorrect** statement among them:

(1) Entropy of adsorption is negative

(2) Enthalpy of adsorption is negative

(3) On adsorption decrease in surface energy appears as heat

(4) On adsorption, the residual forces on the surface are increased

Question Number : 79 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In the isolation of metals, calcination process usually results in:

(1) Metal oxide

(2) Metal carbonate

(3) Metal sulphide

(4) Metal hydroxide

Question Number : 80 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The least number of oxyacids are formed by:

(1) Chlorine

(2) Fluorine

(3) Sulphur

(4) Nitrogen

Question Number : 81 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The cation that will not be precipitated by H_2S in the presence of dil HCl is:

(1) Co^{2+}

(2) As^{3+}

(3) Pb^{2+}

(4) Cu^{2+}

Question Number : 82 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

An aqueous solution of a salt X turns blood red on treatment with SCN^- and blue on treatment with $K_4[Fe(CN)_6]$, X also gives a positive chromyl chloride test. The salt X is:

(1) $FeCl_3$

(2) $Fe(NO_3)_3$

(3) $CuCl_2$

(4) $Cu(NO_3)_2$

Question Number : 83 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which molecule/ion among the following cannot act as a ligand in complex compounds?

(1) CN^-

(2) CH_4

(3) CO

(4) Br^-

Question Number : 84 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The correct statement on the isomerism associated with the following complex ions.

(a) $[Ni(H_2O)_5NH_3]^{2+}$

(b)$[Ni(H_2O)_4(NH_3)_2]^{2+}$ and

(c) $[Ni(H_2O)_3(NH_3)_3]^{2+}$ is:

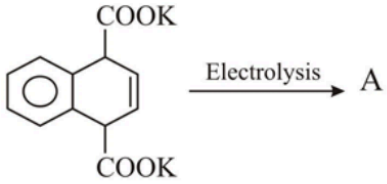
(1) (a) and (b) show only geometrical isomerism

(2) (a) and (b) show geometrical and optical isomerism

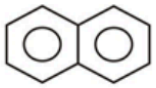
(3) (b) and (c) show geometrical and optical isomerism

(4) (b) and (c) show only geometrical isomerism

Question Number : 85 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

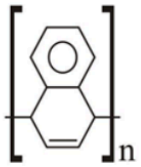


A is :

(1) 

(2) 

(3) 

(4) 

Question Number : 86 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In the presence of a small amount of phosphorous, aliphatic carboxylic acid reacts with chlorine or bromine to yield a reaction in which, α−hydrogen is been replaced by halogen. This reaction is known as

(1) Etard reaction

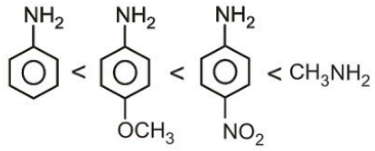
(2) Wolff-Kischner reaction

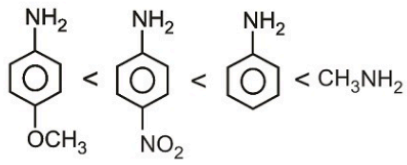
(3) Rosenmund reaction

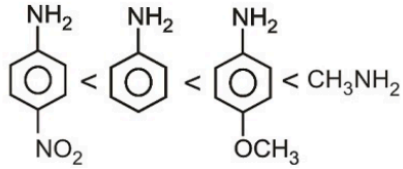
(4) Hell-volhard-zelinsky reaction

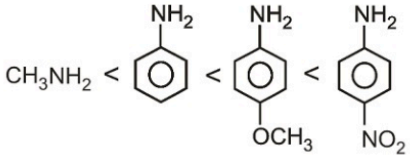
Question Number : 87 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The correct order of basicity is

(1) 

(2) 

(3) 

(4) 

Question Number : 88 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Match the polymers in **column-A** with their main uses in **column-B** and choose the correct answer:

	Column - A		**Column - B**
A.	Polystyrene	**i.**	Paints and lacquers
B.	Glyptal	**ii.**	Rain coats
C.	Polyvinyl chloride	**iii.**	Manufacture of toys
D.	Bakelite	**iv.**	Computer discs

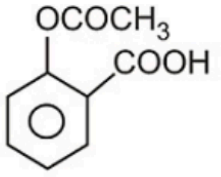
(1) A - iii , B - i , C - ii , D - iv

(2) A - ii , B - i , C - iii , D - iv

(3) A - ii , B - iv , C - iii , D - i

(4) A - iii , B - iv , C - ii , D - i

Question Number : 89 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No



is used as:

(1) Antacid

(2) Insecticide

(3) Antihistamine

(4) Analgesic

Question Number : 90 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Complete hydrolysis of starch gives:

(1) Galactose and fructose in equimolar amounts

(2) Glucose and galactose in equimolar amounts

(3) Glucose and fructose in equimolar amounts

(4) Glucose only